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MINUTES OF THE JUDICIAL COMMISSION MEETINGS HELD AT ROME IN CONNECTION WITH THE VI INTERNATIONAL CONGRESS FOR MICROBIOLOGY SEPTEMBER, 1953

MEETING OF 3rd SEPTEMBER

Present were Prof. R. E. Buchanan (Chairman), Dr. C. H. Andrewes, Prof. A. J. Kluyver, Prof. E. G. D. Murray, Prof. Th. Thjøtta and Dr. S. T. Cowan (Secretary).

Minute 1. The meeting was called to order by the Chairman.

Minute 2. An apology was received for absence from Dr. Stapp who nominated Dr. H. Bortels as his alternate. Apologies for absence were also received from Prof. Wikén, Dr. Ramsbottom, Prof. van Niel, Dr. Sordelli, Dr. Lwoff, and Prof. Renaux.
The meeting accepted Dr. H. Bortels as Dr. Stapp's alternate.
It was agreed that Prof. A. A. Miles should act as alternate for Dr. Andrewes when he could not be present in person.

Minute 3. Adoption of Rules of Procedure.
Rules of procedure for the conduct of the Judicial Commission drafted by the secretary were adopted with one minor alteration; the rules are as follows:

Rules of Procedure for the Judicial Commission

1. The Chairman and Vice-Chairman shall be elected by members of the Commission (Commissioners) and shall hold office for the unexpired portion of their terms as Commissioners. If they are re-elected Commissioners they will be eligible for re-election as Chairman and

Vice-Chairman. The Chairman and Vice-Chairman shall not be of the same class, so that the terms of office of Chairman and Vice-Chairman will not expire simultaneously.

2. When the Chairman is unable to attend a meeting, the Vice-Chairman will undertake the duties of the Chairman, and will, pro tempore, have all the powers of the Chairman.

3. The Commission meets at the time of each Congress, and at its first meeting shall consider the nomination of alternates for absent Commissioners (Draft Proposal 60). Except in the election of Chairman and Vice-Chairman, nominees approved by the Commission will have the voting rights of the Commissioners they represent.

4. A minimum of five Commissioners, who must include the Chairman or Vice-Chairman and at least one Permanent Secretary, can proceed to the nomination and approval of alternates for members not attending the Congress. After alternates have been approved, seven Commissioners and approved alternates shall make a quorum.

5. All votes shall be taken by a show of hands unless a secret ballot is demanded by at least one-third of the Commissioners (and alternates) present. The votes of 8 or more Commissioners are required to approve an official OPINION or an amendment of the International Bacteriological Code of Nomenclature, but on other subjects a simple majority will suffice. In the event of a tie the Chairman shall have a casting vote. When members wish to record a unanimous decision, a fresh vote may be called for and taken.

6. The closure of a discussion may be proposed and seconded at any time after the discussion on one subject has proceeded for more than 30 minutes. The Chairman must put such a motion to the vote without further discussion.

7. Proposals (motions that have been published in the International Bulletin of Bacteriological Nomenclature and

Taxonomy will be proposed and seconded from the floor, and the Chairman will announce the result of the vote.

8. Proposals (motions) that have not been published and amendments to published proposals shall be made in writing or typescript and will be signed by the proposer and seconder. The Chairman will record on the motion paper the result of the vote or votes, and these papers will be preserved by the Permanent Secretaries until the Minutes have been written.

Minute 4. Approval of Agenda. The Chairman presented the detailed agenda. Approval was given.

Minute 5. Proposals for amendment of the bacteriological code.

(Page references in this and other minutes, unless otherwise specified, are to the International Bulletin of Bacteriological Nomenclature and Taxonomy Vol. 3, Nos. 2 + 3, June, 1953.)

Title of the Code. The Secretary presented a proposal that the name of the code should be changed to International Code of Bacteriological Nomenclature; this was seconded by Dr. Murray. After discussion it was agreed unanimously that Dr. Thjøtta's amendment, seconded by Dr. Murray, should be accepted. This amendment read as follows: It is proposed that the title of the bacteriological code should be changed from International Bacteriological Code of Nomenclature to International Code of Nomenclature of Bacteria and Viruses, with a short title of Bacteriological Code.

Draft Proposal 1 (p. 32) was approved unanimously. It was agreed that separate publication of the amended code should be undertaken. Consideration of publication in languages other than English will be by letter ballot.

Draft Proposals 2, 3, 4, 5, 6, 7, 8 and 9 (pp. 33 to 37) were approved unanimously.

Draft Proposal 10 (pp. 37-8). Consideration was given to the alternative proposals 10a and 10b. Unanimous approval was given to proposal 10a with the modification that the last

sentence should become a recommendation and not be part of Rule 2. The Recommendation was phrased as follows: Names of new orders and suborders should preferably be based upon the name of a contained family.

Draft Proposal 11 (p. 38). Consideration was given to the alternative proposals 11a and 11b. Draft proposal 11b was approved unanimously.

Draft Proposal 12 (p. 39). It was agreed unanimously that this proposal should be rejected.

Draft Proposal 13 (p. 39). The proposal was accepted unanimously. It was further agreed that the Committee on Bacteria of the Botanical Congress (Dr. O. N. Allen, Chairman) be requested to confer with the suitable botanical committee with reference to the tribal ending -eae.

Draft Proposal 14 (pp. 41-44). It was agreed that because of the rejection of draft proposal 12 the sentence

> "The nomenclatural type genus of a family whose name is recognized as an exception (See Note Rule 3) may be fixed by the Judicial Commission, preferably at the time that approval to the exception is made."

in paragraph (1) should be deleted. It was further agreed that the last sentence of the paragraph beginning "A neotype culture" should read as follows:

> "It should agree with the diagnosis given by the original describer and should be recommended by at least three separate workers familiar with the species, and their agreed recommendation approved by the Judicial Commission."

The last paragraph of proposal 14 was referred to Drs. Andrewes and Murray for consideration and report. Voting on the proposal was deferred until the next meeting.

Draft Proposal 15 (p. 44) was approved unanimously.

Draft Proposal 16 (p. 44). It was agreed to delete the following words:

. . . ."upon the recommendation of a committee of experts" from the third sentence for the reason that this point had been covered in draft proposal 14. With this modification the proposal was accepted unanimously.

Draft Proposals 17, 18, 19, 20 and 21 (pp. 45-46) were approved unanimously.

Draft Proposal 22 (p. 46). The part in parenthesis is to be deleted from the Rule and is to be made into an annotation. With this modification the draft proposal was approved unanimously.

Draft Proposal 23 (p. 47) was approved unanimously.

Draft Proposal 24 (p. 47). It was agreed unanimously that draft proposal 24 should be rephrased as follows:

> "An author when publishing the name of a new taxon should designate the type and, in the case of a species or sub-species, the collection where the type strain or equivalent is preserved."

Draft Proposals 25, 26, 27, 28, 29 and 30 (pp. 47-49) were unanimously approved.

The meeting was adjourned until September the 4th, 1953.

MEETING OF 4th SEPTEMBER

Present were Prof. R. E. Buchanan (Chairman), Dr. C. H. Andrewes, Dr. H. Bortels, Miss V. Crossley (alternate for Dr. J. Ramsbøttom), Prof. A. J. Kluyver, Prof. E. G. D. Murray, Prof. Th. Thjøtta and Dr. S. T. Cowan (Secretary).

Minute 5 (continued).

The actions taken at the meeting on 3rd September, 1953, were adopted unanimously.

Draft Proposal 14 (deferred from 3rd September). Dr. Andrewes and Professor Murray recommended that an

asterisk should be inserted after the word culture on the fourth line of the paragraph starting "Recommendation 9" (p. 43) and another after the word cultures in the last line on p. 43; as a footnote the following should be added: Culture is to be interpreted as including every method of maintaining organisms in a living state (in a medium, in a host by passage, in cells or exudates, or desiccated).
As modified, the draft proposal 14 was accepted unanimously.

Draft Proposals 31, 32, 33, 34, 35, 36, 37, 38, 39 (pp. 49-51) were approved unanimously.

Draft Proposal 40 (p. 52). The first alternative was accepted unanimously. Dr. Murray proposed and Dr. Cowan seconded that the problem of the overlapping of generic names of plants and bacteria should be studied by the Botanical Committee on Bacteria to determine whether it would be advisable to replace the word plants in the first alternative draft proposal by the words algae and fungi. This proposal was carried unanimously.

Draft Proposal 41, 42 and 43 (pp. 52-53) were approved unanimously.

Draft Proposal 44 (pp. 53-54) was considered briefly but action was deferred until after consideration of later proposals.

Draft Proposal 45 (p. 54) and Appendix A (pp. 64-69). Appendix A was considered first. It was noted that through a typographical error the letter u after the dash following ou in line 10 on page 67 had been omitted and should be inserted. With this correction Appendix A was unanimously approved. Draft Proposal 45 was replaced by the proposals presented on pp. 63-64, which were accepted unanimously.

Draft Proposals 46 and 47 (p. 54) were approved unanimously.

Draft Proposal 48 (p. 55). Draft A was accepted unanimously with the inclusion of "or y" between the word vowel and the comma at the end of the first line.

Draft Proposal 49 (pp. 55-56). A decision on this proposal

was deferred until after consideration of what changes should be made to make this Recommendation a Rule.

Draft Proposal 50 (p. 57) was approved unanimously.

Draft Proposal 51 (p. 57) and Appendix B (pp. 70-72) were considered together.
Draft proposal 51 was approved unanimously, and Appendix B, as amended, will be considered at the next meeting. It was proposed by Dr. Cowan and seconded by Dr. Murray that Provision 5 of the Bacteriological Code should authorize a list of preferred spellings for names of taxa and epithets, and that wherever it is stated in the Bacteriological Code that a spelling may be corrected, such correction can only be made with the approval of the Judicial Commission. Approved spellings will be published in the list of preferred spellings. This was approved unanimously and the Chairman was asked to prepare the necessary addition or change to Provision 5 and to report to the next meeting.

Draft Proposals 52, 53, 54, 55 and 56 (pp. 57-58) were approved unanimously.

Draft Proposal 57 (p. 59). In the last line of the paragraph labelled c the word may should be substituted for the word will.
As amended, the draft proposal was approved unanimously.

Draft Proposal 58 (p. 60) was amended to read as follows:
Provision 4, Section B, Subsection 8. One or other of the Permanent Secretaries shall be designated a member of each subcommittee and shall be responsible only for advising the specialist subcommittee on the interpretation of the Bacteriological Code.
With this amendment the proposal was approved unanimously.

Draft Proposal 59 (pp. 60-62). It was proposed that the words second or should be inserted before the word casting in paragraph 7. With this amendment the draft proposal was unanimously approved.

Draft Proposal 60 (p. 62). It was proposed that paragraph b

be amended to read as follows:
b. If no nomination is made by the Commissioner, the Judicial Commission will elect an alternate from members of the Congress, preferably members of the Committee on Bacteriological Nomenclature.

The Commission was adjourned until September 5th, 1953.

MEETING OF 5th SEPTEMBER, 1953

Present were: Prof. R. E. Buchanan (Chairman), Dr. C. H. Andrewes, Prof. A. J. Kluyver, Prof. E. G. D. Murray, Prof. Th. Thjøtta, and Dr. S. T. Cowan and Prof. T. Wikén (Secretaries). Alternates present were Miss V. Crossley (for Dr. Ramsbottom), Dr. R. Lovell (for Prof. C. B. van Niel) and Dr. Joan Taylor (for Prof. E. Renaux).

Minute 5 (continued)
Draft Proposal 49 (pp. 55-56). The Chairman's recommendation was approved unanimously that Rule 27 Note 5 should have the following added at the end of the first sentence: "(See Provision 5 B 5)", and that Note 6 should become Note 7; the Draft Proposal 49 should become Rule 27 Note 6; other changes in the lettering of the Recommendations of Rule 27 should be: 27 j becomes 27 h; 27 k becomes 27 j; 27 l becomes 27 k; 27 m becomes 27 l; 27 n becomes 27 m.

Draft Proposal 51 (p. 57 and Bulletin, Vol. 1, p. 31). At the end of the first sentence of Provision 5 B 5 add "and a list of preferred spellings of names and taxa and specific epithets."
Appendix B. At the end of the first paragraph of Appendix B the last sentence is to be revised to read: "Authors of new names are urged to make choices in conformity with the following recommendations. Corrections of spellings of existing names authorized by this appendix should be approved by the Judicial Commission and included in the list of preferred spellings (Prov. 5 B 5).
These changes were approved unanimously.

Draft Proposal 61. Rule 27 Recommendation 27c(4), insert

at end of third sentence: "the Scandinavian ø (ö), æ (ä) and å become oe, ae and aa." Also in Recommendation 27 d add the following sentence: "The Scandinavian ø (ö), æ (ä) and å become oe, ae and aa".
These changes were proposed by Dr. Thjøtta and approved unanimously.

Draft Proposal 62. The Chairman and Secretaries were instructed to prepare an amendment to Provision 5 B 2 to modify the methods of requesting and challenging Official OPINIONS. Requests for OPINIONS should be accompanied by a fully documented statement of the relevant facts; any challenge of an OPINION should also be accompanied by a reasoned and documented argument.

Minute 6. It was agreed unanimously that the OPINION on the generic name Bacillus issued in 1936 should be referred to as OPINION A (1936).

OPINION 4, conserving the generic name Bacterium had been challenged by Drs. Borman, Kauffmann and others. It was agreed that the two original requests for the conservation or rejection of the name Bacterium should be referred to the Nomenclature Committee.

OPINION 3, relating to the gender of names of bacterial genera having -bacter as the final component, had been challenged telegraphically by Dr. R. S. Breed. After consideration the Commission unanimously confirmed its adherence to the original OPINION.

Minute 7. OPINIONS requested but not yet approved. File No. 4 (p. 75) was approved in principle with the request that it be referred to the Botanical Committee on Bacteria with the suggestion that concurrent action is desirable.

File No. 6. No action taken and the file closed.

File No. 8. (p. 77) The following OPINION was approved. "The generic name Chlorobacterium Guillebeau 1890 shall be placed in the list of nomina generum rejicienda."

File No. 23 (p. 78). The consensus of opinion was that it may be well to conserve Staphylococcus, but that a final decision should be deferred until experimental work on both sides of the Atlantic has made progress.
A new type strain for Staphylococcus aureus has been proposed by Cowan, Shaw and Williams (in press).

File No. 28 (p. 79). The draft proposal was approved unanimously.

File No. 37 (pp. 79-80). The Commission approved in principle the conservation of Streptococcus agalactiae, but with instructions to the Editorial Board to discuss with the proponents of this conservation before designating the authority for the name.

File No. 39 (p. 80). Action postponed.

File No. 41 (p. 80). The original spelling of the specific epithet was equuli. A formal OPINION is considered unnecessary.

File No. 49 (p. 80-81). The following OPINION was approved: "Gallionella Ehrenberg shall be placed in the list of nomina generum conservanda with the type species Gallionella ferruginea Ehrenberg."
The Botanical Committee on Bacteria is asked to discuss with the appropriate botanical committee the rejection of Gallionella Ehrenberg as a genus of algae.

File No. 52 (p. 81). The draft proposal in the Bulletin was approved.

File No. 53 (p. 81-82). Action postponed until there has been a report from the Subcommittee on Viruses.

File No. 54 (p. 82-84). Shigella species nomenclature and citation of authority.
The first sentence of Draft proposal 1 was approved with the deletion of "(was not)" and "(is not)".
With the deletion of "(is not)" in all three proposals, Draft Proposals 2, 3 and 4 were approved unanimously.

Draft Proposal 5. The first sentence was amended to read as follows:
"A type or standard culture is to be designated by the Enterobacteriaceae Subcommittee of the International Nomenclature Committee for each of the four species."

A new Draft Proposal 6 was proposed by Dr. Murray and seconded by Dr. Cowan and was approved unanimously. Proposal 6 read as follows: A culture belonging to the species Shigella flexneri, Shigella boydii, Shigella sonnei could be completely identified by appending to the name "serotype.. . . . "

File No. 57 (p. 84) was approved unanimously.

File No. 49 (p. 85-86). Draft Proposals 1 and 2 were approved unanimously.

File No. 56 (pp. 87-108).
The following names were approved for conservation:
Beggiatoa, Klebsiella, Kurthia, Neisseria, Nocardia, Pasteurella and Leptotrichia.
Trevisan's generic names listed for rejection:
Babesia, Bacteriopsis, Billetia, Cenomesia, Cornilia, Dicoccia, Eucornilia, Eumantegazzaea, Eupacinia, Euspirillum, Leptotrichiella, Mantegazzaea, Octopsis, Perroncitoa, Pleurospora, Pseudospira, and Pseudospirillum.

Trevisan's generic names that are illegitimate because synonyms of earlier generic names:
Bollingera, Rasmussenia, Schuetzia, Winogradskya.

The following generic names of Trevisan require further study before the preparation of an OPINION:
Pacinia and Gaffkya.

File No. 65 (p. 109-110). The following names of bacterial genera are illegitimate as they are later homonyms of protozoa:
Astasia Mayer, Astasia Pribram, Castellanella Pacheco and Rodrigues, Charon Holmes, Coccomonas Orla-Jensen, Listerella Pirie, Palmula Prevot, Pfeifferella Buchanan,

Phytomonas Bergey et al, Rhizomonas Orla-Jensen, and Rhodosphaera Buchanan.

Draft Proposal (p. 114) was approved unanimously.

The meeting adjourned until Tuesday, 8th September 1953 at 16.00 hours.

MEETING OF 8th SEPTEMBER, 1953

Present were: Prof. R. E. Buchanan (Chairman), Prof. A. J. Kluyver, Prof. E. G. D. Murray, Prof. Th. Thjøtta and Dr. S. T. Cowan and Prof. T. Wikén (Permanent Secretaries). Prof. A. A. Miles attended as alternate for Dr. C. H. Andrewes.

Minute 7. Proposal to amend the Bacteriological Code.

Draft Proposal 62, referred from the meeting of 5th September, was submitted for consideration. The proposal, which was agreed to unanimously, read:

Insert between the first and second sentences of Provision 5 B 2 the following: "A request for an OPINION should be accompanied by a fully documented statement of the relevant facts; when a request is not supported by adequate evidence it shall be returned to the sender for revision. When an OPINION is challenged the basis of the challenge shall be stated and supported by a documented statement of the relevant facts."

An annotation could explain that the Commission will indicate the deficiences of the statement and will suggest how it could be improved.

Minute 8. Report of the Editorial Board

Dr. Buchanan, Chairman of the Board, reviewed the history of the establishment of the International Bulletin of Bacteriological Nomenclature and Taxonomy. He reported difficulties in producing such a bulletin without adequate financial backing. However, financial support from several scientific bodies had been provided and this help was greatly appreciated. The circulation of the Bulletin is still small, but an

increasing demand from libraries can be expected. Dr. Murray proposed that enquiries should be made in Holland and elsewhere as to the cost of printing the BULLETIN by lithography.

The Report was adopted unanimously.

Minute 9. Reference back of OPINION 4
At its meeting on 7th September the Nomenclature Committee had referred back to the Commission OPINION 4 with the instruction to reject the generic name Bacterium and the family name Bacteriaceae.
It was agreed that time was needed to prepare a revision of OPINION 4.
The Chairman will prepare OPINION 4 (revised) rejecting the generic name Bacterium and the family name Bacteriaceae. The draft will be circulated to the Commissioners and postal approval of its wording will be sought.

Minute 10. Choice of the type strain of the species Escherichia coli. Dr. Cowan reported that he had asked various experts to examine the descendant of Escherich's original strain of Bacterium coli commune (NCTC 86, ATCC 4157). The experts agreed that the strain was culturally and biochemically typical, but unfortunately was not typable serologically. Dr. Cowan was asked to explore the possibility of selecting as type a strain that was serologically typable.

The meeting adjourned until Friday, September 11th.

MEETING OF 11th SEPTEMBER, 1953

Present were: Prof. R. E. Buchanan (Chairman), Dr. C. H. Andrewes, Prof. A. J. Kluyver, Prof. E. G. D. Murray, Prof. Th. Thjøtta, and Dr. H. Bortels, Dr. S. T. Cowan and Prof. T. Wikén (Joint Secretaries).

Minute 11. New Commissioners

The Class of 1962 consists of

Prof. R. E. Buchanan	Prof. A. A. Miles
Prof. A. J. Kluyver	Prof. E. G. D. Murray

Minute 12. Election of Officers

Prof. R. E. Buchanan was unanimously re-elected Chairman. Prof. C. B. van Niel was elected Vice-Chairman.

Minute 13. Adjournment

Prof. Buchanan asked the Secretaries to express the gratitude of the Commission to the Director and members of the staff of the Istituto di Igiene for all the help they have rendered which has made it possible for the Commission to do so much work.

The Commission unanimously expresses its thanks to Prof. Buchanan for the work he had put into preparations for the meeting, and for his Chairmanship during the meetings. Thanks were also expressed to the Joint Secretaries.

The Commission adjourned at 4:45 p.m.

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MINUTES OF MEETINGS OF THE INTERNATIONAL COMMITTEE ON BACTERIOLOGICAL NOMENCLATURE HELD AT ROME IN CONNECTION WITH THE VI INTERNATIONAL CONGRESS FOR MICROBIOLOGY, SEPTEMBER 1953

MEETING OF 7th SEPTEMBER

Present were: Prof. S. D. Rubbo and Mr. V. B. D. Skerman (Australia), Dr. D. Klaushofer (alternate for Prof. A. Szilvinyi, Austria), Dr. A. G. Lochhead and Prof. E. G. D. Murray (Canada), Dr. F. Kauffmann (Denmark), Prof. M. Grimes (Eire), Prof. U. Vartiovaara (Finland), Dr. H. Bortels and Dr. H. Seeliger (alternates for Prof. C. Stapp and Prof. H. Haupt, respectively, Germany), Dr. C. H. Andrewes, Dr. T. Gibson, Prof. A. A. Miles and Dr. G. S. Wilson (Great Britain), Prof. A. J. Kluyver (Holland, Chairman), Prof. G. Penso (Italy), Dr. T. Asai (Japan), Dr. S. D. Henriksen and Prof. Th. Thjøtta (Norway), Prof. C. de Oliveira (Portugal), Prof. O. N. Allen and Prof. R. E. Buchanan (U.S.A., Prof. Buchanan also being an alternate for Prof. M. Eisler-Terramare and Prof. A. Janke, Austria), Dr. S. T. Cowan and Prof. T. Wikén (Permanent Secretaries).

Minute 1. Rules of Procedure
Draft Rules of procedure were circulated and were approved unanimously. The rules were:

Rules of Procedure for the International Committee on Bacteriological Nomenclature

1. The election of a Chairman and a Vice-Chairman and the two Permanent Secretaries in accordance with Provision 4, and the election of members of the Judicial Commission in accordance with Provision 5, shall be made by all members present at the meeting. Alternates for absent members shall not have votes in these elections.

2. When two or more meetings of the International Committee are to be held at one Congress, nominations for Chairman, Vice-Chairman and Commissioners will be called for at the

first meeting. Nominations should be submitted in writing to one of the Permanent Secretaries before the start of the meeting at which elections are to take place. When only one meeting is being held at a Congress, nominations will be received up to the time on the agenda preceding the elections.

3. Ballots will be made in writing, separate ballots being held for the Chairman, Vice-Chairman, and Commissioners. In voting for Commissioners, each member will have as many votes as there are vacancies on the Judicial Commission.

4. Except in the election of officers and Commissioners, alternates for absent members shall have the voting rights of the members they represent.

5. Except in the election of Officers and Commissioners, all votes shall be taken by a show of hands unless a secret ballot is demanded by at least one-quarter of the members present. A simple majority will suffice to approve all proposals except amendments to the Bacteriological code which, by Provision 5, Section B, Subsection 3, require approval by 70 per cent of members voting. In the event of a tie or otherwise indecisive vote, the Chairman shall have a second or casting vote.

6. The closure of a discussion may be proposed and seconded at any time after the discussion on one subject has proceded for more than thirty minutes. The Chairman must put such a motion to the vote without further discussion.

7. Proposals (motions) that have appeared in the International Bulletin of Bacteriological Nomenclature and Taxonomy will be proposed and seconded from the floor, and the Chairman will record the result of the vote.

8. Unpublished proposals (motions) and amendments from the floor shall be in writing or typescript and will be signed by the proposer and seconder. The Chairman will record on the motion paper the result of the vote or votes, and these papers will be preserved by the Permanent Secretaries until the Minutes have been written.

9. Twenty-five members and alternates shall make a quorum; a meeting attended by fewer members cannot pass emendations of the Bacteriological Code, change rules of procedure, reject OPINIONS of the Judicial Commission, or elect officers and Commissioners.

Minute 2. Membership of the Committee

The resignations of
Prof. H. Chiari
Prof. Otto Rahn
Prof. V. Puntoni
were received and accepted with regret.

It was known that
Prof. Ing. J. Krenn
Prof. J. W. Bigger
Prof. R. Müller
had died since the last meeting.

New members nominated were approved as follows:

Country	Candidate
AUSTRIA	Dr. R. L. Zischka
CHILE	Dr. A. Graf Marin
	Dr. J. San Miguel
	Dr. O. Wilhelm
FINLAND	Dr. H. H. G. Gyllenberg
	Prof. E. Mustakallio
	Dr. K. Penttinen
	Prof. U. Vartiovaara
GERMANY	Dr. H. Seeliger
GREAT BRITAIN	Dr. T. Gibson
HOLLAND	Prof. A. C. Ruys
	Prof. Dr. J. Smit
	Prof. Dr. J. D. Verlinde
	Prof. Dr. J W. Wolff

ITALY	Prof. A. Castellani
JAPAN	Dr. T. Asai Dr. S. Kojima Dr. K. Kominami
NEW ZEALAND	Mr. M. B. Buddle Dr. L. Kirschner Dr. H. R. Whitehead
PORTUGAL	Prof. Candido de Oliveira
SWITZERLAND	Prof. Dr. E. Grasset Prof. Dr. P. Kästli Prof. Dr. H. Mooser Dr. Ch. Terrier

Minute 3. Election of new Joint Secretary

Dr. R. S. Breed resigned the post of Joint Secretary for Non-medical Bacteriology in December, 1951. Prof. T. Wikén had acted temporary in his place and was now proposed as Permanent Joint Secretary. He was elected unanimously.

Minute 4. Election of a Life Member

Dr. Breed's work for the Committee was recognized by his election to Life Membership in the Committee.

Minute 5. Alternates for Life Members

The Joint Secretaries asked the Committee for a ruling on the acceptance of alternates for Life Members. It was the opinion of the Committee that Life Membership was an individual honour, and that an alternate could not be accepted.

Minute 6. Amendments to the Bacteriological Code

Prof. Buchanan explained the changes proposed to bring the Bacteriological Code more into line with the revised Botanical Code. All the proposed changes (for details see the Minutes of the Judicial Commission) had been studied in

detail by the Judicial Commission and approved unanimously. The Committee confirmed unanimously these recommendations of the Commission.

Minute 7. OPINIONS issued.

OPINIONS 1 - 5 had been issued and published in the International Bulletin. Objection had been raised to OPINIONS 3 and 5.

OPINION 3. After discussion the Commission's recommendation adhering to the OPINION issued was approved unanimously.

OPINION 4 had been challenged by Drs. Borman, Kauffmann and Haupt. In the discussion Dr. Buchanan explained that the Judicial Commission thought that the Committee should bear in mind that originally two requests for an OPINION had been before the Commission, one to conserve and the other to reject the generic name Bacterium.
Dr. Kauffmann's proposals, seconded by Prof. Thjøtta, were:

I. To reject the generic name Bacterium and to refer the matter back to the Judicial Commission.

II. To reject the family name Bacteriaceae.

Voting: For, 15; Against, 3.

Dr. Kauffmann's other proposal, 3: To change Provisions 4 and 5 to clarify the validity of OPINIONS between publication and the next International Congress, was withdrawn without discussion.

Minute 8. Nominations requested.

The Chairman asked for nominations for four Commissioners to succeed Profs. Buchanan, Kluyver, Murray and Stapp who were eligible for re-election.
He also asked for nominations for the Chairman and Vice-Chairman of the Committee.

The meeting adjourned until Friday 11th September.

MEETING OF 11th SEPTEMBER

Present were: Prof. A. Sordelli (Argentina), Mr. V. B. D. Skerman (Australia), Dr. D. Klaushofer (alternate for Prof. A. Szilvinyi, Austria), Dr. A. C. Thaysen (British West Indies), Dr. A. G. Lochhead and Prof. E. G. D. Murray (Canada), Dr. F. Kauffmann (Denmark), Prof. M. Grimes (Ireland), Prof. U. Vartiovaara (Finland), Dr. A. R. Prévot and Dr. G. Segretain (France), Dr. H. Seeliger and Dr. H. Bortels (Germany, alternates for Prof. C. Stapp and Prof. H. Haupt, respectively), Dr. C. H. Andrewes, Dr. T. Gibson, Prof. A. A. Miles and Dr. G. S. Wilson (Great Britain), Prof. A. J. Kluyver (Chairman) and Prof. J. W. Wolff (Holland), Dr. T. Asai and Dr. T. Ogata (Japan, the last one as an alternate for Dr. S. Kojima), Prof. Th. Thjøtta (Norway), Prof. C. de Oliveira (Portugal), Prof. S. Gard and Prof. R. Nilsson (Sweden), Prof. H. Mooser (Switzerland), Prof. O. N. Allen, Prof. R. E. Buchanan and Dr. C. B. Philip (U.S.A., the last one as an alternate for Prof. C. B. van Niel), Dr. S. T. Cowan and Prof. T. Wikén (Permanent Secretaries).

Minute 9. Approval of action on 7th September.

The actions taken on 7th September were approved unanimously.

Minute 10. Discrepancies between Draft Proposals 57 and 60 and the Rules of Procedure.

The Secretaries pointed out discrepancies between the wording of proposals 57 and 60 and the rules of procedure, and proposed that in proposal 57 after the words "appointed member" should be inserted "except in the election of officers and Commissioners".
This was approved unanimously.
It was further proposed that in Draft Proposal 60, after the word "Commissioner", there should be inserted "except in the election of officers".
This also was approved unanimously.

Minute 11. Change in rules of procedure.

Rule 9 of the Committee rules specified the need for 25 members or alternates to form a quorum. The Committee

approved unanimously a resolution that this number should be reduced to 15.

Minute 12. Reports of the Subcommittees.

Reports were presented by various Subcommittees, Anaerobes, Enterobacteriaceae, Leptospira, Neisseriaceae, and virus, and publication was authorized.

The Streptococcus Subcommittee had been reformed and amalgamated with the provisional Streptococcus Serotyping Subcommittee.

The provisional Staphylococcus phage-typing Subcommittee was accepted as a permanent subcommittee.

It was suggested that in future the subcommittees should prepare their reports before each Congress and, if possible, publish them in the Bulletin.
They should be presented at the latest by the first day of the Congress.

Minute 13. Enteric Phage-Typing Committee.

The anomalous situation of the Enteric Phage-Typing Committee was discussed and it was decided that the Secretaries should write to the new Committee of the International Association of Microbiological Societies to suggest that it should become a subcommittee of the Nomenclature Committee.

Minute 14. Election of Commissioners.

Five members had been nominated and election was held.

Prof. R. E. Buchanan, Prof. A. J. Kluyver, Prof. A. A. Miles and Prof. E. G. D. Murray were elected.

Minute 15. Election of Officers.

Prof. E. G. D. Murray was elected Chairman and Prof. U. Vartiovaara was elected Vice-Chairman.

The Committee adjourned at 4:20 p.m.

INTERNATIONAL BULLETIN OF BACTERIOLOGICAL NOMENCLATURE AND TAXONOMY
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CLASSIFICATION OF STREPTOCOCCI, GROUPS A, B, C AND D*

Report to the Subcommittee on Streptococcus at the Fifth International Congress for Microbiology, Rio de Janeiro, August, 1950
by the Chairman, J. Howard Brown,
Johns Hopkins University, Baltimore, Maryland, USA

I reiterate opinions which I expressed on several occasions (Third International Congress, 1939; American J. Med. Sciences, 1944; Fourth International Congress, 1947), and which were not completely reported in the necessarily brief Proceedings of the Congresses.

Frankly, no one knows what a bacterial species is, because we lack the aids commonly employed in the differentiation of species of higher plants and animals, e.g., diverse morphology, cross fertility, and genetic relationships.

Admittedly, natural (genetic) relationships should be followed if they are apparent. If not, serology should be employed when applicable, likewise the relatively stable physiological characters (including pathogenicity), and convenience in the sense that it is important that different micro-organisms shall be referred to by names, specific and varietal, to avoid throwing science into confusion (Principle 1). In fact, I think the last is the chief justification for any system of nomenclature.

Many members of the genus Streptococcus are found to possess C polysaccharide antigens which serve to identify them with certain serological "Groups", and there are many "type" antigens within most of the Groups. I think we have progressed far enough to say that all members of a species of Streptococcus should belong to a single serological Group but that more than one species may exist within a Group (e.g., Group C). It may also be said that members of a single species may possess different type

*Publication of this report has been requested to complete the record of the 1950 International Congress of Microbiology.

antigens although, in my opinion, if different members of a species possess mutually exclusive or distinctive type antigens, accompanied by differences in physiology, pathogenicity, or habitat, such differences may be of varietal significance, and are not to be regarded merely as "variants".

The above leads up to my theme. I have given considerable study to the nomenclature and rank of members of Streptococcus Groups A, B, C, and E; and somewhat less to Group D. I have recognized 4 species in Group A (S. pyogenes Rosenbach, S. infrequens Holman, S. scarlatinae Klein em. Evans, and S. alactosus Brown), 4 species in Group B (S. agalactiae Lehmann and Neumann em. Frost and Engelbrecht, S. asalignus Frost, Gumm and Thomas, S. opportunus Brown, and an unnamed species of human origin described by Brown), 4 species in Group C (S. equi Sand and Jensen, S. equisimilis Frost and Engelbrecht, S. zooepidemicus Frost and Engelbrecht, and S. dysgalactiae Diernhofer), and 4 species in Group D (S.faecalis Andrewes and Horder, S. liquefaciens Sternberg, S. zymogenes MacCallum and Hastings, and S. durans Sherman and Wing.

The question now in my mind is whether it might be helpful as well as rational to regard some of the above species as varieties. Sherman, Stark and Mauer (1937) suggested that S. zymogenes and S. liquefaciens might be regarded as varieties of S. faecalis. If so, the correct names would be Streptococcus faecalis v. faecalis S. faecalis v. zymogenes and S. faecalis v. liquefaciens. Whether S. durans should also be regarded as a variety of Streptococcus faecalis is due for consideration.

I would make a similar proposal with regard to the streptococci of serological Groups A and B. The similarity of the streptococci of Group A as to habitat, physiology and pathogenicity and the relative infrequence of S. infrequens, S. scarlatinae and S. alactosus has led many bacteriologists to ignore their differences and to include all of them in S. pyogenes. Very well: I propose to regard them as varieties and name them Streptococcus pyogenes v. pyogenes, S. pyogenes v. infrequens, S. pyogenes v. scarlatinae and S. pyogenes v.

alactosus. It may be that S. potens Evans 1947 should also be included as S. pyogenes v. potens.

At the Fourth International Congress for Microbiology I proposed that the bovine mastitis streptococci of serological Group B be designated as Streptococcus agalactiae v. agalactiae, S. agalactiae v. mastitidis and S. agalactiae v. asalignus. This would leave the veterinary literature, in which all are called Streptococcus agalactiae, untouched (varieties not determined). I also proposed the name Streptococcus opportunus for a Group B streptococcus of human origin, physiologically and pathogenically different from the bovine streptococci; also another Group B streptococcus of human origin (Sp. ?) which I now propose as a variety of S. opportunus, namely S. opportunus v. pseudomastitidis (n. var.). This and S. opportunus v. opportunus are both opportunist pathogens of man having their natural habitat in the throat and vagina. The varietal epithet, pseudomastitidis, seems appropriate because the organism resembles so closely the bovine variety, mastitidis. The work of El Ghoroury (Am. J. Pub. Hlth., in press), in agreement with Simmons and Keogh, 1940, found the bovine strains serologically distinct from the human strains of Group B streptococci, none of the bovine strains being typed with the sera prepared against human strains and vice versa. For these reasons and others, (1939) I recognize S. agalactiae and S. opportunus as different species.

The differences between members of serological Group C as to source, pathogenicity and physiology seem to me sufficient to regard them as different species.

The characteristics of these various streptococci are presented in the accompanying table which is modified and adapted from that of Swift (Bacterial and Mycotic Infections of Man - Dubos, 1948).

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The differences between members of serological Group C as to source, pathogenicity and physiology seem to me sufficient to regard them as different species.

The characteristics of these various streptococci are presented in the accompanying table which is modified and adapted from that of Swift (Bacterial and Mycotic Infections of Man - Dubos, 1948).

CHARACTERISTICS OF VARIOUS STREPTOCOCCI

(Adapted from Table by Swift in Bacterial and Mycotic Infections of Man - Dubos, 1948.)

SPECIES, VARIETY	S. pyogenes var				S. agalactiae var.			S. opportunus var.		S. equi	S. equisimilis	S. zooepidemicus	S. dysgalactiae	S. faecalis var.				S. tardus	S. uberis
	pyogenes	infrequens	scarlatinae	alactosus	agalactiae	mastitidis	asalignus	opportunus	pseudomastitidis					faecalis	liquefaciens	zymogenes	durans		
Group Antigen (C polysaccharide)	A	A	A	A	B	B	B	B	B	C	C	C	C	D	D	D	D	E	?
Dominant Host or Habitat	man	man	man	man	cow	cow	cow	man	man	horse	man	animals	cow	intestinal tract				cow	cow
Action on red blood cells:																			
Hemolysis (β)	+	+	+	+	-	+	+	+	+	+	+	+	-	-	-	+	+	+	-
Green or brown (α)	-	-	-	-	±	-	-	-	-	-	-	-	+	±	±	-	-	-	±
Indifferent (γ)	-	-	-	-	±	-	-	-	-	-	-	-	-	±	±	-	-	-	±
Soluble hemolysin	+	+	+	+	-	±	±	±	±	+	+	+	-	-	-	±	±	+	-
Lysis of human fibrin	+	+	+	+	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-
Gelatin liquefied	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	(+)	-	-	-
Arginine split forming NH_3	+				+	+				+	+	+	+	+	+	+	+	+	+
Sodium hippurate split	-	-	-	-	+	+	+	+	+	-	-	-	-	±	±	±	+	+	+
Growth tolerance:																			
Resists heating at 60° C. 30 min.	-	-	-	-	-	-	-	-	-	-	-	-	-	+	+	+	+	-	±
Grows at 45° C.	-	-	-	-	-	-	-	-	-	-	-	-	-	+	+	(+)	(+)	-	-
" " 40° C.																			
" " 10° C.	-	-	-	-	-	-	-	-	-	-	-	-	-	+	+	+	+	-	+
Grows on 40 % bile blood agar	(-)	(-)	(-)	(-)	(+)	(+)	(+)			(-)	(-)	(-)	-	+	+	+	+	-	-
" " 10 % bile blood agar	±	±	±	±	+	+	+			±	±	±	-	+	+	+	+	-	(+)
Grows in broth with 6.5 % NaCl	-	-	-	-	-	-	-			-	-	-	-	+	+	+	+	-	-
" " " " 4.0 % $NaCl_1$																			
Grows in broth adjusted pH 9.6	-	-	-	-	-	-	-	-	-	-	-	-	-	+	+	+	+	-	-
Grows in 0.1 % methylene blue milk	-	-	-	-	-	-	-	-	-	-	-	-	-	+	+	+	+	-	-
" " 0.3 % " " " "																			

CHARACTERISTICS OF VARIOUS STREPTOCOCCI (cont'd.)

(Adapted from Table by Swift in Bacterial and Mycotic Infections of Man - Dubos, 1948.)

SPECIES, VARIETY	S. pyogenes var.				S. agalactiae var.			S. opportunus var.		S. equi	S. equisimilis	S. zooepidemicus	S. dysgalactiae	S. faecalis var.				S. tardus	S. uberis
	pyogenes	infrequens	scarlatinae	alactosus	agalactiae	mastitidis	asalignus	opportunus	pseudomastitidis					faecalis	liquefaciens	zymogenes	durans		
Litmus milk:																			
Acid produced	+	+	+	-	+	+	+	-	+	-	-	+	+	+	+	+	+	+	+
Clot formed	(-)		+	-	+	+	+	-	+	-	-	(-)	±	+	+	+	+	-	±
Reduces litmus before clotting	(-)			-	-	-	-			-	-	-	-	+	+	+	±	-	-
Reduces " after clotting	±		+	-	+	+	+			-	-	-	-				+	-	-
Methylene blue in milk (1:5000):																			
Reduces	-				(-)	(-)	-	±	(+)				+					-	±
Mean final pH in 1% glucose broth	5.2	5.2	5.2	5.2	4.6	4.6	4.6	4.6	4.6	5.2	5.0	5.0	5.0	4.2	4.2	4.2	4.2	4.5	4.8
Carbohydrates split:																			
Trehalose	+	+	+	+	+	+	+	+	+	-	+	-	+	+	+	+	(+)	+	+
Sorbitol	-	-	-	-	-	-	-	-	-	-	-	+	+	+	+	+	-	+	+
Glycerol	-				(-)[2]	(-)[2]	±[2]	(+)[2]	(+)[2]	-	+	-	-	±	(+)	(+)	-	±	±
Mannitol	-	+	-	+	-	-	-	-	-	-	-	-	-	(+)	+	+	(-)	±	+
Lactose	+	+	+	-	+	+	+	-	+	-	-	+	+	+	+	+	+	+	+
Sucrose	+	+	+	+	+	+	+	+	+	+	+	+	+	±	+	+	-	±	+
Raffinose	-	-	-	-		-	-	-	-	-	-	-	-	±	±	±	-	-	-
Salicin	+	+	-	±	+	+	-	+	+	+	+	+	±	+	+	+	+	±	+
Inulin	-	-	-	-	-	-	-	-	-	-	-	-	-		-	-	-	-	+
Esculin	+				-	-	-	-	-	-	±	+	-[3]	+	-	+	-	±	+

(+) or (-), Usually + or -. [1] Data for Group N only. [2] Some late glycerol fermenter , 7 days. [3] Sometimes slight. [4] Detected by formol titration.

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CLASSIFICATION OF THE GENUS STREPTOCOCCUS

Report to the Subcommittee on Streptococcus at the Sixth International Congress of Microbiology, Rome, Italy, September, 1953, by J. Howard Brown, Johns Hopkins University, Baltimore, Maryland

Since 1915 I have been interested in the IDENTIFICATION of streptococci. I prefer the word IDENTIFICATION to CLASSIFICATION because the prerequisite of classification is identification. Unless objects are identified they cannot be classified. Classification consists in bringing together similar objects under similar names and in such a way as to indicate, if possible, natural relationships; hence, we have genera and species. If, within species, there are members showing fairly stable differences not great enough to be regarded as different species, they may be classified as varieties of the species, but in no case should they lose their identity so long as they are recognizable.

Nomenclature is the language, the vocabulary, of classification and, for its use in bacteriology, an International Bacteriological Code of Nomenclature has been adopted. Principle 1 of this code reads "The essential points in nomenclature are (1) to aim at fixity of names; (2) to avoid or to reject the use of forms and names which may cause error or ambiguity or throw science into confusion."

In suggesting that I speak on this topic Dr. Breed wrote "We always have 'splitters' and 'lumpers' with us x x". I immediately assumed that I was a "splitter" because I have favored retaining the names of certain streptococci which are either uncommon or which differ from better known species in so-called minor details, such as hemolysis, host habitat, fermentation of a few carbohydrates, serological typing, and even specific virulence, instead of "lumping" them together as possible, though inconvenient, variants of better known species. I have insisted upon maintaining their identity whether as separate species or varieties: I have needed names for them. Knowledge of their existence has led me to look for them outside of the "lump"; otherwise they would have been missed or ignored.

BACTERIOLOGICAL NOMENCLATURE AND TAXONOMY

In the nature of things, in botany and zoology, one expects to find more varieties than species and more species than genera. Why should it be otherwise in bacteriology? It is true that (Rule 6) "Names of species are binary combinations consisting of the name of the genus followed by a single specific epithet", but (Rule 7) "Names of subspecies (varieties) are ternary combinations consisting of the name of the genus followed by the specific and the subspecific epithets in order".

Reference should be made to the Report to the Subcommittee on Streptococcus presented to the Fifth International Congress of Microbiology in 1950 (see this BULLETIN p. 163).

Now where do I stand? If I decide that serological Group A includes several species of Streptococcus I am a "splitter"; if I include these as varieties of a single species, Streptococcus pyogenes, I am a "lumper", but not as great a "lumper" as if I were to ignore all varieties. Error, ambiguity and confusion may result from the use of too few names as well as from the use of too many names. Simplicity attempted in this way may result in complexity. Nomenclature must be adequate.

What help may we get from the "Key to the species of genus Streptococcus" in Bergey's Manual, 6th Ed.? The "Pyogenic group", with which I am mostly concerned today, is described as follows:

> No growth at 10° C. No growth at 45° C. Generally beta hemolytic. Generally do not curdle milk and reduce litmus slowly if at all. Mannitol and glycerol generally not fermented. Not tolerant of 0.1 per cent methylene blue, 6.5 per cent NaCl and pH 9.6. Produce ammonia from peptone.

It may be noted that the 11 characteristics there listed in the general dexcription 5 are doubtful or equivocal. In the following steps of the Key to the Pyogenic group there is no place for lactose negative members of serological Groups A or B and the only lactose negative members of Group C are under the designation "Lactose may or may not be fermented". There is no mention of salicin in the Key to the Pyogenic

group although this is a critical glucoside for certain members of Serological Groups A and B. A key that fails to open so many locks is certainly not a master key.

If you examine the table on Characteristics of Various Streptococci by Swift in Bacterial and Mycotic infections of Man - (Dubos, 1948 and 1952), similar discrepancies will be noted. Only one species and no varieties are indicated among the streptococci of serologic Groups A and B. Of the 31 characteristics tabulated for Streptococcus pyogenes and Streptococcus agalactiae 15 of the former and 11 of the latter are indicated as variable or equivocal. This is too many for adequate description and identification of an organism. When these two species are subdivided into varieties, as has been done in the revised table which accompanies this discussion, the number of variable characteristics drops to 5 or less for each variety and the remaining variable characteristics are of a quantitative rather than a qualitative character.

Based upon this revised table, a Key to the Species and Varieties of Groups A, B, C and E of the genus Streptococcus is presented.

KEY TO THE SPECIES AND VARIETIES OF GROUPS A, B, C AND E OF THE GENUS STREPTOCOCCUS

1. Facultative anaerobic species.

   A. Pyogenic group. No growth at 10° C. or at 45° C. No growth at pH 9.5. In broth not tolerant of 0.1 per cent methylene blue or 6.5 per cent NaCl.

      a. Hippurate -, trehalose +, sorbitol -. All beta hemolytic.

         1. Streptococcus pyogenes, Group A.
         1.1 Variety pyogenes; mannitol -, salicin +, lactose +.
         1.2 Variety infrequens; mannitol +, salicin +, lactose +.
         1.3 Variety scarlatinae; mannitol -, salicin -, lactose +.

1.4 Variety alactosus; mannitol +, salicin +, lactose -.

b. Hippurate +, trehalose +, sorbitol -, mannitol -, Group B.

a. Alpha zones in blood agar plates, salicin +, lactose +.

2.1 Streptococcus agalactiae var. agalactiae.

b. Small beat zones usually later surrounded by larger zones of partial hemolysis. Not agglutinated by typing sera prepared against Streptococcus opportunus.

2.2 Streptococcus agalactiae var. mastitidis; salicin +, lactose +.

2.3 Streptococcus agalactiae var. asalignus; salicin -, lactose +.

c. Zones in blood agar similar to those of Streptococcus agalactiae var. mastitidis. Not agglutinated by typing sera prepared against Streptococcus agalactiae.

3.1 Streptococcus opportunus var. opportunus; salicin +, lactose -.

3.2 Streptococcus opportunus var. pseudomastitidis (n. var.); salicin +, lactose +.

c. Hippurate -, trehalose -, mannitol -. Beta hemolytic. Group C.

4. Streptococcus equi; sorbitol -, lactose -.

5. Streptococcus zooepidemicus; sorbitol +, lactose +.

d. Hippurate -, trehalose +, sorbitol -, lactose -, Beta hemolytic.

6. Streptococcus equisimilis; Group C.
(Distinguishable from Streptococcus equi by fermentation of trehalose; from Streptococcus pyogenes var. alactosus (GpA) by failure to germent mannitol.)

e. Hippurate -, trehalose +, sorbitol +, mannitol-, salicin +, lactose +. Not beta hemolytic. Group C.

7. Streptococcus dysgalactiae.

f. Hippurate +, trehalose +, sorbitol +, mannitol +,

salicin +, lactose +.

8. Streptococcus uberis; non-hemolytic.
9. Streptococcus tardus; Group E. Beta hemolytic. Hippurate hydrolysis detectable only by formal titration.

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STREPTOCOCCUS AND PNEUMOCOCCUS SUBCOMMITTEE
(Provisional Subcommittee on Serotyping of Streptococci)

To the Secretaries of the International Nomenclature Committee

A meeting was held in Rome at 2:00 p.m. on September 9th, 1953, attended by the following persons:

Dr. V. D. Allison, Belfast; Dr. S. T. Cowan, London; Dr. A. Ferris, Melbourne; Prof. A. Grumbach, Zurich; Dr. E. M. Lund, Copenhagen (representing also Dr. Kauffmann, Copenhagen); Mr. W. R. Maxted, London, Dr. R. Pakula, Warsaw; Cdr. J. R. Seal, Great Lakes, U.S.A.; Dr. R. Wahl, Paris; Dr. R.E.O. Williams, London; Dr. A. T. Wilson, Wilmington, U. S. A.

Dr. V. D. Allison and Dr. E. M. Lund were the only members of the established Streptococcus and Pneumococcus Subcommittee present. They agreed to recommend that this Subcommittee should be amalgamated with the provisional subcommittee convened by Dr. Williams. The proposed Subcommittee would then have as its scope the classification and nomenclature of the aerobic streptococci, including pneumococci. It should have three sections: (1) medical and veterinary, (2) dairy, and (3) pneumococcus.

The following persons were proposed as members of the Subcommittee, it being recognized that there are certainly others who should be invited to join, particularly from among dairy bacteriologists.

(1) Medical and Veterinary - Dr. V. D. Allison, Belfast; Dr. Bazeley, Australia; Dr. A. Ferris, Melbourne; Dr. R. Lancefield, New York; Mr. W. W. Maxted, London; Dr. K. Skadhauge, Copenhagen; Dr. R. Pakula, Warsaw; Mr. I. H. Pattison, Compton, England; Dr. A. W. Stableforth, Weybridge, England; Dr. E. Updyke, Chamblee, U. S. A. Dr. R. Wahl, Paris; Dr. R. E. O. Williams, London; Dr. A. T. Wilson, Wilmington, U.S. A.

(2) Dairy - Dr. Arne Hansen, U. S. A.; Dr. A. T. Mattick, Shinfield, England; Dr. Mocquet, Paris; Prof. M. Seelmann, Kiel; Prof. S. M. Sherman, U. S. A.

(3) Pneumococcus - Dr. F. Kauffman, Copenhagen; Dr. E. M. Lund, Copenhagen; Dr. A. Walter, U. S. A.; Dr. B. Eddy, U. S. A.

Dr. Allison and Dr. Williams were elected Chairman and Secretary respectively of the whole committee and of the medical and veterinary section. It was proposed that Dr. Kauffmann should be invited to become the chairman of the pneumococcus section, with Dr. Lund as secretary.

There was discussion of the designation of reference laboratories. Dr. Wilson reported that he was prepared to give assistance with the investigation of new types and similar problems. It was understood that samples of typing serum were available, in the United States from the U. S. Public Health Service at Chamblee. Dr. Lancefield had agreed to assist in an advisory capacity. Dr. Williams reported that the Streptococcal Reference Laboratory at Colindale was prepared to assist in the investigation of new types, etc. and to supply samples of serum and strains to laboratories commencing typing; it could not undertake to continue supply of serum in quantities sufficient for routine use.

It was agreed to report the conclusions of the meeting to the International Nomenclature Committee, with the recommendation that the new Subcommittee be formally recognized, and that authority be granted to invite the persons named and others considered appropriate to join the Subcommittee.

INTERNATIONAL BULLETIN OF BACTERIOLOGICAL NOMENCLATURE AND TAXO OMY
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SUBCOMMITTEE ON PHAGE TYPING OF STAPHYLOCOCCI

To the Secretaries of the International Committee on Bacteriological Nomenclature:

A meeting was held in Rome at 2:00 p.m. on Tuesday, September 8th, 1953, comprising the following persons interested in the phage typing of staphylococci:

Dr. V. D. Allison, Belfast; Dr. J. E. Blair, New York; Dr. Bynoe, Ottawa; Dr. K. R. Ericksen, Copenhagen; Dr. G. Gabrielli, for Prof. Buonomini, Pisa; Dr. R. Pakula, Warsaw; Prof. G. Rita, Rome; Dr. P. M. Rountree, Sydney; Prof. C. Ruys, Amsterdam; Prof. Th. M. Vogelsang, Bergen; Dr. R. Wahl, with Mlle. Fouace and Dr. J. Pillet, Paris; Dr. G. Wallmark, Stockholm, Dr. R. E. O. Williams, with Miss Joan Rippon, London.

Dr. J. E. Blair was elected to the Chair.

There was general agreement that a Subcommittee on the phage typing of staphylococci could serve a useful purpose. It was felt that the Subcommittee ought to have a member from each country in which phage typing was carried out. In his or her country each member could convene a panel of the workers engaged in phage typing so that the Subcommittee could be informed of the consensus of opinion.

There was discussion of several technical aspects of the phage-type classification, and it was agreed to ask a working party, comprising Dr. Rountree, Dr. Wahl, and Dr. Williams (with Dr. Rountree as convener), to produce a report on possible alterations in the method of numbering the phages, and also on methods for the characterizing of new phages.

It was agreed to recommend to the International Nomenclature Committee that a formal Subcommittee should be established, with the same initial membership as that of the present meeting.

INTERNATIONAL BULLETIN OF BACTERIOLOGICAL NOMENCLATURE AND TAXONOMY
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CRITERIA SUITABLE FOR SPECIES DIFFERENTIATION IN CELLULOMONAS AND A REVISION OF THE GENUS

Francis E. Clark [1]

Evidence has recently been presented (2) that many of the cellulolytic bacteria of Kellerman and co-workers (10, 11, 12, 13) belong in the Corynebacteriaceae. Accordingly, the genus Cellulomonas has been emended and its transfer to that family has been proposed (3). During the course of the work on Cellulomonas, several of the type cultures in the genus, including that of the type species, were made available to the writer by Dr. Nathan R. Smith, one of the initial co-authors (11). These type cultures [2] had been maintained in his laboratory for a period of about forty years. Their availability has provided an opportunity both to evaluate the stability and suitability of criteria employed for species differentiation in Cellulomonas and to consider the correctness of the names of the several species that have been assigned to the genus. From the laboratory data accumulated and from examination of published descriptions, recognition or disposition has been made of twenty-seven kinds of bacteria described as species of Cellulomonas.

It is the purpose of this paper to present evidence concerning the legitimacy of these twenty-seven putative species. Of these, ten are retained in Cellulomonas, fourteen names are reduced to synonyms, and three species are excluded from the genus.

CHARACTERISTICS OF THE GENUS CELLULOMONAS

Inasmuch as several organisms placed in Cellulomonas

1 U. S. Department of Agriculture and Iowa Agricultural Experiment Station, Ames, Iowa. Journal Paper No. 2259, Project 965, of the Iowa Agricultural Experiment Station.

2 These cultures are available from the American Type Culture Collection, 2029 M Street, NW, Washington, D. C.

by earlier workers are herein excluded from the genus, it is appropriate briefly to describe Cellulomonas before evaluating criteria for the separation of species within this group.

An earlier discussion (3) has summarized my reasons for placing Cellulomonas in the family Corynebacteriaceae and for recognizing at least three genera (Corynebacterium, Arthrobacter, and Cellulomonas) within that family. The species in these genera show angular, branched, and irregular cells, and nearly all recent students of them have stated that they should be grouped in the same family. In some instances, new combinations have been proposed in the genus Corynebacterium. Cellulomonas fimi has been designated Corynebacterium fimi by Jensen (8), and Arthrobacter globiforme has been designated Corynebacterium globiforme by Wood (21). Jensen (9) has recently stated that the animal pathogens, the soil saprophytes, and the plant pathogens of the coryneform bacteria "constitute Corynebacterium sensu lato."

The writer believes that various cellulolytic and globiform organisms from soil should not be placed in the genus whose type species is Corynebacterium diphtheriae, even though such organisms are recognized in Corynebacteriaceae. It has been proposed that Arthrobacter Conn and Dimmick (5) be retained. This genus is differentiated from Corynebacterium by its failure to produce acid from fermentable sugars and by its ability to liquefy gelatin and to grow satisfactorily on synthetic media. Jensen (9) speaks of Arthrobacter as follows: "In this group the energy metabolism is almost wholly oxidative, synthetic ability is well developed (growth with inorganic nitrogen and without accessory factors), and proteolytic power is considerable." In addition, it may be pointed out that young cells of Arthrobacter spp. are much more commonly Gram-negative than are those of the animal diphtheroids. On aging, cells of Arthrobacter commonly become Gram-positive, and coccoid or globiform in appearance, as described by Conn and Dimmick (5). Reports of motility in Arthrobacter are sufficiently numerous to show that

motility must be recognized within this group. Despite scattered reports to the contrary, motility has not yet been demonstrated in organisms that can beyond reasonable doubt be considered as animal diphtheroids. Jensen (9) likewise regards the animal parasitic corynebacteria as genuinely nonmotile, and the soil and plant coryneform bacteria as "incidentally" motile.

Cellulomonas is differentiated both from Corynebacterium and Arthrobacter by its ability to cause disintegration of cellulose. Cellulomonas also is differentiated from Arthrobacter by the ability of the former to produce distinct acidity in dextrose broth. In my experience, Gram-negative staining is more commonly encountered in cells of Cellulomonas than in cells of Arthrobacter. Cellulomonas usually is Gram-negative during the first 24 hours of growth, thereafter Gram-positive or Gram-variable staining is secured on cells grown under favorable conditions. In cultures several days old, the Gram reaction is usually negative.

The ability of Cellulomonas to attack cellulose is apparently a very stable characteristic. It remains demonstrable in cultures maintained in Smith's laboratory for forty years. Siu (19) has remarked that the term "cellulolytic" is used by some workers simply to denote a loosening of the adhesion of the fibers in filter paper strips even though actual cellulose destruction is negligible. The Cellulomonas species recognized below and for which type cultures have been available possess the ability to dissect filter paper strips (0.7 by 6 cm.) standing half immersed in 0.5 per cent peptone broth. The dissection of the filter paper strips in such tubes occurs at the surface of the broth.

CRITERIA FOR SPECIES IDENTIFICATION

The differential criteria most used in the separation of species of Cellulomonas, both by the first students of the genus and in more recent monographs, including the several editions of Bergey's Manual (1), have been the following: motility, gelatin liquefaction, chromogenesis, action on milk, production of ammonia and nitrite, and production of

indole. These criteria are discussed in the following paragraphs.

Motility: Kellerman and co-workers (10, 11, 12, 13) described about two-thirds of their proposed species as motile. Both motile and nonmotile species are represented among the cultures that have been maintained. Cellulomonas biazotea, C. cellasea, and C. gelida, initially described as motile, have been found motile in recent examinations (4). C. flavigena, C. uda, and C. fimi were initially described as nonmotile (10, 11, 13). The first two have been found nonmotile, while the last has shown feeble motility. Flagella have been demonstrated in gold-shadowed cell preparations of C. fimi examined with an electron microscope (4). Inasmuch as the property of motility appears constant, within reasonable limits of errors of observation, it appears desirable to retain this criterion for separation of species in Cellulomonas.

Gelatin liquefaction: Kellerman and co-workers (10, 11, 12, 13) employed gelatin stab cultures for determining liquefaction. For slowly growing and weakly gelatinolytic bacteria, this technique is not entirely reliable. It will be pointed out below that Kellerman and co-workers listed certain species as non-gelatinolytic in some discussions but in others listed the same species as very slowly gelatinolytic. In the current work, cultures of Cellulomonas were grown on gelatin agar plates, and tests for gelatin hydrolysis were made according to the method of Frazier (6). All cultures studied were found capable of gelatin hydrolysis, including Cellulomonas gelida and C. subalba, initially described as non-gelatinolytic. Accordingly, certain species separations that have formerly been made on the basis of gelatin liquefaction no longer appear tenable.

Chromogenesis: Kellerman and co-workers (10, 11, 12, 13) found that approximately one-third of their cellulolytic bacteria showed yellow pigmentation on beef agar. Of their yellow chromogenic and cellulolytic cultures, four have been examined, and all have produced yellow or lemon-yellow growth on nutrient agar. Of four cellulolytic cultures initially described as non-chromogenic, all have shown white,

ivory, or light cream-colored growth on nutrient agar. Various workers have pointed out the pitfalls in using chromogenesis for taxonomic purposes. Nevertheless, yellow chromogenesis appears to be a relatively stable characteristic within the genus Cellulomonas, and therefore it is retained as an acceptable criterion for the differentiation of species.

Action on milk: With but few exceptions, all species of Cellulomonas noted in the sixth edition of Bergey's Manual (1) are described as capable of producing acid in milk. The excepted species (Cellulomonas rossica, C. folia, and C. ferruginea, to be discussed below) do not meet the generic requirements for Cellulomonas in several respects and should be excluded from the genus. Kellerman and co-workers differentiated certain of their species on the basis of acidity only in milk, in contrast to acidity and coagulation or digestion. Coagulation and digestion when present appeared slowly, usually after several weeks of incubation. Jensen (8), in reporting on the cultural responses of Cellulomonas fimi, noted in addition to an acid reaction in milk, coagulation after 3 weeks at 37°C., but not at 28°to 30°C. McBeth and Scales (13) reported acid production only for C. fimi in milk. Reliance on variations in amount of acidity or extent of digestion in milk for species differentiation in Cellulomonas does not appear to be indicated.

Ammonia, nitrite, and indole production: Kellerman and co-workers (10, 11, 12, 13) noted ammonia, nitrite, and indole production for several of their cellulolytic bacteria. Inasmuch as the carbohydrate fermentation responses of the same bacteria were of little differential value, Kellerman et al. (11), McBeth (12), and the several editions of Bergey's Manual (1) have relied largely on differences in ammonia, nitrite, and indole reactions for species differentiation.

Of the three tests, nitrite production from nitrates has been found to offer the most promise for current use. The type species Cellulomonas biazotea was initially described as nitrite positive, and the type culture still produces nitrites from nitrates. Similarly, the positive nitrite reac-

tions initially reported for C. cellasea, C. flavigena, C. uda, and C. subalba, and the negative nitrite response initially reported for C. gelida, have been confirmed. C. fimi, initially reported nitrite positive, has been found nitrite negative. Jensen (8) found C. fimi to be nitrite positive.

Ammonia production was noted by Kellerman and co-workers for nearly one-half of their species. In our work, no species of Cellulomonas has been found to produce ammonia. Insofar as type cultures available are concerned, ammonia production therefore appears of doubtful value for species separation. Notwithstanding this, discarding the use of the ammonia test is not recommended at the present time. In the case of gelatin liquefaction, some species initially reported negative have been found gelatinolytic. There is reasonable probability that their gelatinolysis was initially overlooked because of slow growth or the test conditions employed, and not that the property has since been acquired. With ammonia production, however, the discrepancy is in the other direction - cultures initially reported positive are now found negative. It is possible that their ability to produce ammonia has been lost. Until such time as the question of ammonia production has been investigated in a number of freshly isolated cultures, it appears advisable to accept certain species of Cellulomonas that would not be recognized if ammonia production were discarded entirely from taxonomic consideration.

Kellerman et al. (11) and McBeth (12) found several of their cultures capable of producing indole. No species of Cellulomonas has been found indole positive in this laboratory. Unfortunately, nearly all the type cultures that have been available for testing represent species that initially were reported as indole negative. An exception has been Cellulomonas fimi, initially described as indole positive. Jensen (8) has studied a culture of C. fimi and has also found it indole negative.

The retention of the indole test for differentiation of species of Cellulomonas must be supported by the same reasoning that supports retention of the ammonia production test.

But inasmuch as there exists some doubt on the accuracy of the indole tests reported in the earlier literature, the writer has considered it advisable to disregard the indole test for species differentiation in Cellulomonas. The very few occasions in which the indole test determines whether or not a given species reported in the literature is entitled to recognition will be pointed out below.

Carbohydrate fermentation: Taylor (20) summarized his work on the availability of carbon compounds to the soil bacteria in the genus Arthrobacter with the statement that the inconsistent and changeable reactions produced on different sugars only emphasized the futility of any attempt to classify the organisms on the basis of acid production. With but one exception, carbohydrate fermentation responses have not been found informative for species differentiation in Cellulomonas. C. fimi ferments xylose and arabinose, whereas all other species of Cellulomonas that were tested failed to attack these pentoses.

Other tests: All reputable cultures of Cellulomonas available for study hydrolyzed starch. None produced acetylmethylcarbinol. None hydrolyzed sodium hippurate or uric acid. Cellulomonas gelida and C. subalba caused some browning in lead acetate agar, indicating feeble hydrogen sulfide production. Thermal resistance studies revealed no noteworth differences among the type cultures studied. No serological studies were undertaken.

THE LEGITIMACY OF SPECIES IN CELLULOMONAS

Eighteen species are placed in Cellulomonas in the sixth edition of Bergey's Manual (1) and six nonmotile cellulolytic species previously listed in Cellulomonas are placed in Bacterium. Following Jensen (8), Cellulomonas fimi was transferred to the genus Corynebacterium. The legitimacy of these several species for inclusion in Cellulomonas should be reviewed.

Individual species are discussed in the order in which they appear in the dichotomous key given at the close of this section. Names of species not recognized in the key but considered

synonyms of species names included are discussed immediately following the species with which they are merged. Species excluded from Cellulomonas are discussed last.

1. Cellulomonas biazotea (Kellerman, McBeth, Scales Smith) Bergey et al. 1923.
   Synonyms:
   Bacillus biazoteus Kellerman et al. 1913.
   Proteus cellulomonas var. biazoteus Pribram 1933.

Inasmuch as Cellulomonas biazotea is the type species, it is fortunate both that the type culture has been maintained and that the culture corresponds very closely to its initial description. The culture remains cellulolytic, chromogenic, gelatinolytic, motile, nitrite positive, and ammonia negative.

A minor correction should be made concerning the "optimum temperature 20°C." as given in Bergey's Manual (1). Kellerman et al. (11) stated for all their species: "They grow well from 20° to 37.5°C., and more rapidly at the higher temperature." McBeth (12) stated: "The optimum temperature for most species seems to be between 28° and 33°C."

My observations agree with those of McBeth, and cultural tests have commonly been performed at 30°C. A similar correction, stating the optimum temperature as 28° to 33° C. and not as 20°C, can also be made for the other recognized species of Cellulomonas.

2. Cellulomonas cellasea (Kellerman et al.) Bergey et al. 1923.
   Synonyms:
   Bacillus cellaseus Kellerman et al. 1913.
   Bacillus concitatus McBeth 1916.
   Cellulomonas concitata (McBeth) Bergey et al. 1923.
   Bacillus desiduosus McBeth 1916.
   Cellulomonas deciduosa (McBeth) Bergey et al. 1923.
   Cellulomonas desidiosa (McBeth) Bergey et al. 1939
   Bacillus subalbus Kellerman et al. 1913.
   Cellulomonas subalbus (Kellerman et al.) Clark 1951.

The original description (11) of C. cellasea permits its inclusion in the emended genus Cellulomonas. Such inclusion has been substantiated by examination of the type culture. Culturally and in its biochemical responses, this species resembles C. biazotea, except that C. cellasea produces no yellow pigment. It is considered a legitimate species.

2a. Cellulomonas concitata (McBeth) Bergey et al.

The original description of this organism makes it appear to be correctly placed in Cellulomonas. No culture was available to the writer. Except for the slightly more vigorous growth and the reported production of indole, this organism so closely resembles C. cellasea that its name becomes a synonym of C. cellasea, which has priority of description. If indole-positive cultures otherwise resembling C. cellasea can be isolated and shown to be culturally stable, then recognition of C. concitata might be justified.

2b. Cellulomonas desidiosa (McBeth) Bergey et al.

No culture was available, but this organism likewise appears to be correctly placed in Cellulomonas. Disregarding its reported negative gelatinolysis, C. desidiosa does not differ from C. cellasea, and the name C. desidiosa becomes a synonym of C. cellasea which has priority. Both C. desidiosa and C. concitata (q. v.) were reported by McBeth (12) to be indole-positive.

2c. Cellulomonas subalba (Kellerman et al.) Clark.

Kellerman et al. (11) differentiated Bacillus subalbus from B. pusilus (Cellulomonas pusilla) by the more luxuriant growth of the former on beef agar and by its failure to liquefy gelatin. Discounting its initially reported negative gelatinolysis and ignoring the slight difference reported (11) between its growth on agar ("moderate, flat, white or faintly yellowish white") and that of C. pusilla ("moderate, flat, almost colorless semi-transparent"), there appears justification for uniting these two species. But the

available type culture of Cellulomonas subalba, No. 489 in the American Type Culture Collection, in addition to being weakly gelatinolytic, fails to produce ammonia, and in other respects resembles C. cellasea. The name C. subalba is reduced to a synonym of C. cellasea.

3. Cellulomonas aurogena (Kellerman et al.) Bergey et al. 1923.

Synonyms:

Cellulomonas aurogenes (sic) (Kellerman et al.) Bergey et al. 1923.
Bacillus aurogenus Kellerman et al. 1913.
Cellulomonas flava Sack, 1924.
Cellulomonas flavus (sic) Sack, 1924.
Bacillus gilvus McBeth, 1916.
Cellulomonas gilva (McBeth) Bergey et al. 1923.

No culture of C. aurogena has been available, but the original description appears to place it in Cellulomonas. Until such time as cultures conforming to the description are known, the possibility of identity with C. biazotea is not excluded. Meanwhile, C. aurogena may be recognized as a legitimate species, differentiated from C. biazotea by the reported ability of C. aurogena to produce ammonia.

In their initial description, Kellerman et al. (11) employed the binomial Bacillus aurogenus. In all six editions of Bergey's Manual (1), the name has been cited as B. aurogenes.

3a. Cellulomonas flava Sack, 1924.

No culture has been available. The initial description of this organism placed emphasis on its cellulolytic ability, but presented somewhat limited cultural observations. Its reported motility, yellow chromogenesis, and nitrite and ammonia production seem to identify this bacterium with Cellulomonas aurogena, of which the name C. flava becomes a synonym. Its reported pellicle formation in broth and light brown growth on potato are not typical of C. aurogena.

3b. Cellulomonas gilva (McBeth) Bergey et al. 1923.

No culture has been available, but the original description of this bacterium makes it appear to be correctly placed in Cellulomonas. McBeth (12) differentiated it from C. aurogena largely on the basis of its failure to liquefy gelatin. With its reportedly negative gelatinolysis ignored, its yellow chromogenesis and production of both nitrite and ammonia seem to identify it with C. aurogena. The name C. gilva is reduced to a synonym of C. aurogena.

4. Cellulomonas pusilla (Kellerman et al.)Bergey et al. 1923.

Synonyms:

Cellulomonas pusila (sic) (Kellerman et al.) Bergey et al. 1923.

Bacillus pusilus (sic) Kellerman et al. 1913.

Bacillus caesius Kellerman et al. 1923; Cellulomonas caseia (Kellerman et al.) Bergey et al. 1923. Cellulomonas casei (Kellerman et al.)Bergey et al. 1934. Cellulomonas caesia (Kellerman et al.) Bergey et al. 1939.

Bacillus iugis McBeth 1916.

Cellulomonas iugis (McBeth) Bergey et al. 1923.

No culture of Cellulomonas pusilla has been available, but the species is recognized as legitimate on the basis of its reported ability to produce ammonia and failure to show yellow chromogenesis. Its lack of chromogenesis differentiates it from C. aurogena, and its production of ammonia from C. cellasea.

4a. Cellulomonas caesia (Kellerman et al.) Bergey et al. 1923.

Kellerman et al. (11) differentiated C. caesia from C. pusilla by the ability of the former to cause coagulation and digestion in litmus milk and also by growth on beef agar. C. caesia produced "moderate, flat, thin, slightly bluish fluorescent at angle of 45°" and C. pusilla "moderate flat, almost colorless semi-transparent growth." The lack of other differences makes the recognition of C. caesia as a species appear inadvisable, and the name C.

caesia becomes a synonym of C. pusilla. No cultures have been examined.

4b. Cellulomonas iugis (McBeth) Bergey et al. 1923.

An initial revision of a generic key primarily to correct for gelatin liquefaction brought Cellulomonas iugis and C. pusilla into juxtaposition. Their positive and negative properties as tabulated by McBeth (11) in his summarizing tables 2 and 3 were tabulated as follows:

C. iugis:	-	-	-	-	+	+	*	+	*	+	-	-	+	+	-	+	-
C. pusilla:	-	-	-	-	+	-	-	-	+	-	-	+	+	-	+	-

The two disagreements (marked by asterisks) represented positive gelatin liquefaction and growth on potato for C. iugis and negative gelatin liquefaction and no growth on potato for C. pusilla.

The first disagreement appears to be a typographical error which both McBeth (12) and Bergey's Manual (1) perpetuated in their taxonomic keys. The original description (12) of gelatin liquefaction by C. iugis stated: "Moderate growth at surface and along track of needle at 5 days; napiform liquefaction at 30 days." That (11) for C. pusilla stated: "No surface growth, liquefaction slow, usually becoming infundibuliform or saccate after 15 days."

McBeth (12) described the growth of C. iugis on potato as: "Scant,, glistening colorless growth when very heavily inoculated; light inoculation produces no growth." Kellerman et al. (11) described that of C. pusilla as: "No apparent growth after 20 days, but potato is bleached along the track of the inoculum."

Portions of the initial descriptions of these species have been cited in some detail partly to furnish an example of the extremely minor cultural variations on which McBeth (12) based descriptions of new species. Surely, species distinctions must be more tangible than light or heavy inoculation of potato. The writer does not recognize the two species as distinct, even though no cultures have been examined. The

name C. iugis is made a synonym of C. pusilla.

5. Cellulomonas fimi (McBeth and Scales) Bergey et al. 1923. 1930.

Synonyms:

Bacterium fimi McBeth and Scales 1913.
Cellulomonas fima (McBeth and Scales) Bergey et al. 1923.
Corynebacterium fimi (McBeth and Scales) Jensen 1934.
Bacterium liquatum McBeth and Scales 1913.
Cellulomonas liquata (McBeth and Scales) Bergey et al. 1923.

Jensen (8) found Cellulomonas fimi to show the morphology of the corynebacteria. He concluded that it should not be included in the genus Cellulomonas. At the time of his work he did not have type cultures of other species of Cellulomonas available for study. Subsequent work (2) has shown that the type species C. biazotea as well as others in the genus also show the irregular morphology and staining responses that Jensen encountered in Cellulomonas fimi. With emendation of the genus Cellulomonas, C. fimi is recognized as a legitimate species.

5a. Cellulomonas liquata (McBeth and Scales) Bergey et al. 1923.

McBeth and Scales (13) reported that C. liquata produced a yellow chromogenesis more readily than did C. fimi. Jensen (8) considered the two species as closely related, and the sixth edition of Bergey's Manual (1) stated that the two should be regarded as identical. In our laboratory, comparison of type cultures has shown them to be culturally identical. The synonymy of the name C. liquata with C. fimi suggested by other workers is substantiated.

6. Cellulomonas galba (Kellerman et al.) Bergey et al. 1923.

Synonym:

Bacillus galbus Kellerman et al. 1913.

No culture of this species has been examined, but the original description (11) appears to place the organism in Cellulomonas. C. galba is recognized as a legitimate species. It is differentiated from the yellow chromogens C. biazotea and C. aurogena by the reported failure of C. galba to reduce nitrates to nitrites.

7. Cellulomonas gelida (Kellerman et al.) Bergey et al. 1923.

Synonyms:

Bacillus gelidus Kellerman et al. 1913.
Bacillus albidus McBeth 1916.
Cellulomonas albida (McBeth) Bergey et al. 1923.
Bacillus almus McBeth 1916.
Cellulomonas alma (McBeth) Bergey et al. 1923.
Bacillus bibulus McBeth and Scales 1913.
Cellulomonas bibula (McBeth and Scales) Bergey et al. 1923.

Examination of the type culture of C. gelida has shown it is correctly placed in Cellulomonas. The species is gelatinolytic, contrary to the initial description (11). C. gelida is differentiated from C. cellasea, also non-chromogenic and motile, by the failure of C. gelida to reduce nitrates to nitrites.

7a. Cellulomonas albida (McBeth) Bergey et al. 1923.

No culture has been examined. McBeth (12) differentiated this organism from C. gelida by the less vigorous growth of C. albida and its failure to produce ammonia. C. gelida may also fail to produce ammonia. The older species, i.e., C. gelida, is recognized, and the name C. albida is reduced to synonymy.

7b. Cellulomonas alma (McBeth) Bergey et al. 1923.

Although no culture has been examined, the very slight difference in growth on beef agar which McBeth (12) considered sufficient to differentiate C. albida from C. alma is regarded as insufficient for species separation. The name C. alma is regarded as a synonym of C. gelida.

7c. Cellulomonas bibula (McBeth and Scales) Bergey et al. 1923.

The type culture was found to be non-cellulolytic and to differ in several other respects from the initial description (13). As originally described, C. bibula can be regarded as an indole-positive variant of C. gelida. Otherwise, its reported cultural properties suggest its identity with C. gelida. If indole-positive cultures resembling C. gelida otherwise can be isolated and shown to be culturally stable, then recognition of C. bibula as a separate species could be justified. The name C. bibula is regarded as a synonym of C. gelida.

8. Cellulomonas flavigena (Kellerman and McBeth) Bergey et al. 1923.

Synonyms:

Bacillus flavigena Kellerman and McBeth 1912.
Bacterium flavigena McBeth and Scales 1913.
Bacterium flavigenum Kellerman et al. 1913.
Cellulomonas idonea (McBeth) Bergey et al. 1923.

The type culture of C. flavigena has been found in general agreement with the original description (10), and the species is entitled to recognition in the genus Cellulomonas. Its nonmotility, yellow chromogenesis, and ability to reduce nitrates distinguish it from other recognized species.

8a. Cellulomonas idonea (McBeth) Bergey et al. 1923

No culture is currently available, therefore species recognition or disposition can be made only on the basis of the original description (12). The yellow chromogenesis, production of nitrite, acidity in milk, failure to produce ammonia, and finally its reported nonmotility would identify it with C. flavigena and reduce the name C. idonea to synonymy.

9. Cellulomonas uda (Kellerman et al.) Bergey et al. 1923.

Synonyms:
Bacterium udum Kellerman et al. 1913.
Proteus cellulomonas var. udus Pribram 1933.

C. uda is recognized as a nonmotile, nonchromogenic species of Cellulomonas. The type culture currently available has been found to agree in its characteristics with the original description (11).

10. Cellulomonas acidula (Kellerman et al.) Bergey et al. 1923.

Synonyms:
Bacterium acidulum Kellerman et al. 1913.
Bacterium castigatum McBeth 1916.
Cellulomonas costigata (sic) (McBeth) Bergey et al. 1923.
Cellulomonas castigata (McBeth) Bergey et al. 1939.
Bacterium lucrosum McBeth 1916.
Cellulomonas lucrosa (McBeth) Bergey et al. 1923.

No culture of C. acidula was available, but the reported failure of the species to produce nitrites from nitrates is considered sufficient basis to differentiate C. acidula from C. uda.

10a. Cellulomonas castigata (McBeth) Bergey et al. 1923.

No culture has been available. C. castigata was described by MoBeth (12) as producing more acidity from fermentable carbohydrates than was produced by C. acidula; otherwise, the organisms appear to have been culturally identical. The name C. castigata is made a synonym of C. acidula.

10b. Cellulomonas lucrosa (McBeth) Bergey et al. 1923.

No culture has been available. C. lucrosa was described by McBeth (12) as showing slightly better growth on agar and more turbidity in broth than is shown by C. acidula; otherwise, the organisms appear to have been culturally identical. The name C. lucrosa is made a synonym of

C. acidula.

11. Cellulomonas (?) ferruginea (Rullmann) Bergey et al. 1923.

No culture is available. The original description of Bacillus ferrugineus by Rullmann (15) fails to mention any cellulolytic activity. Rullmann's bacterium produced alkalinity in milk, failed to ferment sugars, produced a rusty brown color on several cultural media, and on nutrient glycerol agar at 37°C., "nach mehreren Tagen durch die ganze Masse grün fluorescierend." Later, van Iterson (7) reported cellulose degradation by a very small bacillus associated with a large coccus. The former he named Bacillus ferrugineus. This name is considered an illegitimate later homonym of B. ferrugineus Rullmann. It is quite probable that the cellulolytic activity observed by van Iterson was caused by a species of Sporocytophaga. There appears no sufficient reason to recognize Bacillus ferrugineus of Rullmann as a species of Cellulomonas.

12. Cellulomonas folia Sanborn 1926.

No culture was studied by the writer. Published descriptions of this species are too fragmentary to permit its inclusion in Cellulomonas. Sanborn and Hamilton (18) stated that carbohydrates were not fermented. According to a Bergey Manual citation of Sanborn's unpublished notes, both acid and gas are slowly produced from carbohydrates. Inasmuch as gas production is not recognized in Cellulomonas, C. folia is excluded from the genus. Its production of alkalinity in milk is also not typical of Cellulomonas.

13. Cellulomonas rossica (Kellerman and McBeth) Bergey et al. 1923.

The initial description of this species does not support its inclusion in Cellulomonas. It was described (10) as causing rapid liquefaction of gelatin, producing alkalinity in milk, and failing to produce acidity in carbohydrate media. The stock culture currently available agrees with the initial

description in several respects but there is one important difference in that it is not cellulolytic. Identification was not made. Morphologically, the organism does not appear to belong to the Corynebacteriaceae.

KEY TO THE SPECIES OF THE GENUS CELLULOMONAS

I. Motile with one or few peritrichous flagella.
  A. Nitrites produced from nitrates.
    1. Xylose and arabinose not fermented.
      a. Ammonia not produced.
        b. Yellow chromogenesis on nutrient agar.
          1. Cellulomonas biazotea.
        bb. White, greyish, or ivory growth on agar.
          2. Cellulomonas cellasea.
      aa. Ammonia produced.
        b. Yellow chromogenesis on nutrient agar.
          3. Cellulomonas aurogena.
        bb. White, greyish, or ivory growth on agar.
          4. Cellulomonas pusilla.
    2. Xylose and arabinose fermented.
      5. Cellulomonas fimi.
  B. Nitrites not produced from nitrates.
    1. Yellow chromogenesis on nutrient agar.
      6. Cellulomonas galba.
    2. White, greyish, or ivory growth on agar.
      7. Cellulomonas gelida.

II. Nonmotile.
  A. Nitrites produced from nitrates.
    1. Yellow chromogenesis on nutrient agar.
      8. Cellulomonas flavigena.
    2. White, greyish, or ivory growth on agar.
      9. Cellulomonas uda.
  B. Nitrites not produced from nitrates.
      10. Cellulomonas acidula.

SUMMARY

From an examination of initial descriptions and in certain instances of type cultures, recognition or disposition has been made of twenty-seven species of bacteria placed in

Cellulomonas by various authors.

Cellulomonas biazotea, C. cellasea, C. aurogena, C. pusilla, C. galba, C. gelida, C. fimi, C. flavigena, C. uda, and C. acidula are recognized as good species. A dichotomous key for their identification has been prepared.

The names of fourteen species previously recognized in Cellulomonas are made synonyms of the above species. Cellulomonas albida, C. alma, and C. bibula are made synonyms of C. gelida. C. concitata, C. desidiosa, and C. subalba become synonyms of C. cellasea. C. flava and C. gilva are made synonyms of C. aurogena, and C. caesia and C. iugis, of C. pusilla. The opinion of other workers that C. liquata is a synonym of C. fimi is substantiated. C. idonea becomes a synonym of C. flavigena, and C. castigata and C. lucrosa, of C. acidula.

Three bacteria heretofore assigned to Cellulomonas fail to meet the requirements for recognition in the genus and are excluded. These species are: Cellulomonas ferruginea, C. folia, and C. rossica.

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Rio de Janeiro, August 24, 1950

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